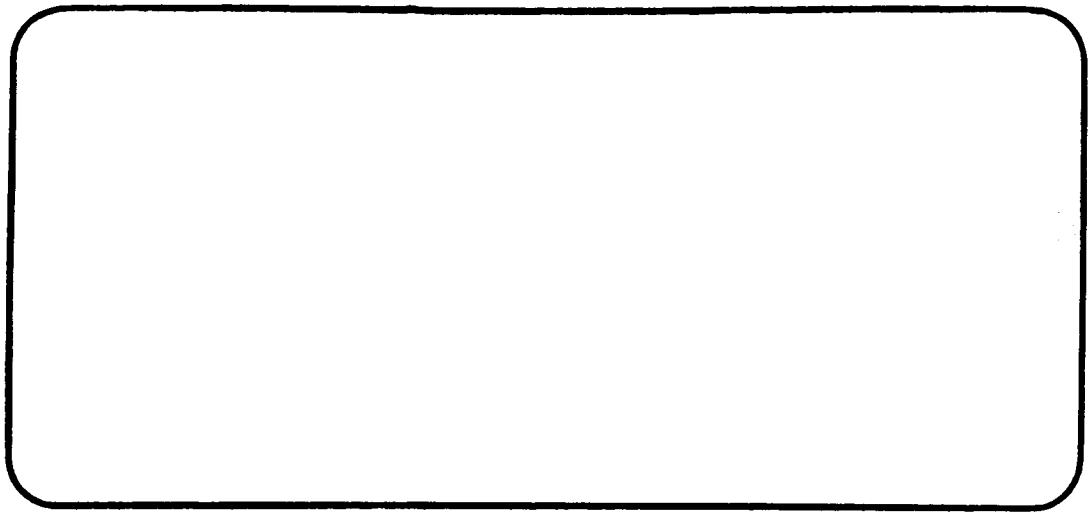

(NASA-CR-124169) STUDY OF THE DYNAMICS OF ORBITAL ASSEMBLIES INCLUDING INTERACTIONS WITH GEOMETRICAL APPENDAGES (TRW Systems) 22 p HC $3.25 CSCL 09B

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Unclas

G3/08 17354

TRW®
SYSTEMS GROUP
ONE SPACE PARK • REDONDO BEACH, CALIFORNIA

STUDY OF THE DYNAMICS OF ORBITAL ASSEMBLIES INCLUDING INTERACTIONS WITH GEOMETRICAL APPENDAGES

Contract Nos. NAS 8-26131
NAS 8-28169

UNIFIED FLEXIBLE SPACECRAFT SIMULATION PROGRAM (UFSSP)

OPERATION MANUAL

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(Updated to include modifications as of 18 December 1972)

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Marshall Space Flight Center
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This report was prepared by TRW Systems Group under Contracts NAS8-26131 and NAS8-28169 for the George C. Marshall Space Flight Center of the National Aeronautics and Space Administration. The work was administered under the technical direction of Mr. Wayne Holland of the Astronautics Laboratory and Dr. Gerald Nurre of the Astrionics Laboratory, George C. Marshall Space Flight Center.

TABLE OF CONTENTS

OPERATION OF UFSSP

1. SOFTWARE/HARDWARE REQUIREMENTS

CDC 6500

This program runs under the TRW/TSS system and requires 55,000 words of core, 5000 words of disk storage and up to 4 tape units during execution. This does not include disk requirements for I/O and overlay/loading. The program is coded in FORTRAN IV.

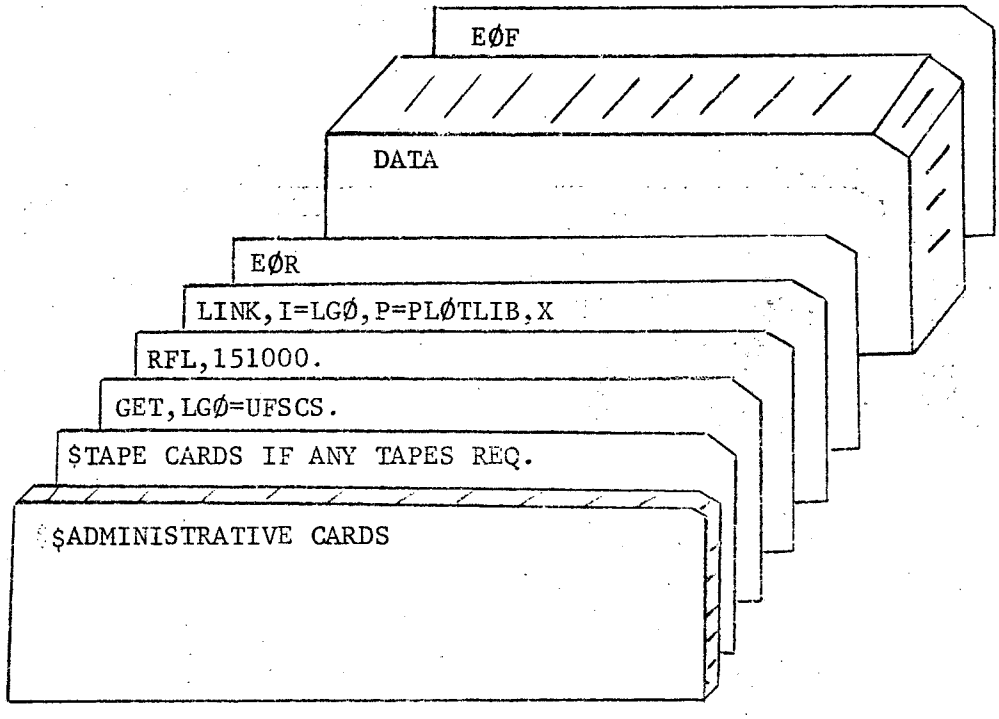
UNIVAC 1108

This program runs under the exec 8 system and requires 54,000 (+ system space) words of core, 5000 words of drum storage and up to 4 tape units (plot tape is a dummy) during operation. This does not include drum requirements for I/O and overlay/loading. The program is coded in FORTRAN IV compatible with FORTRAN V.

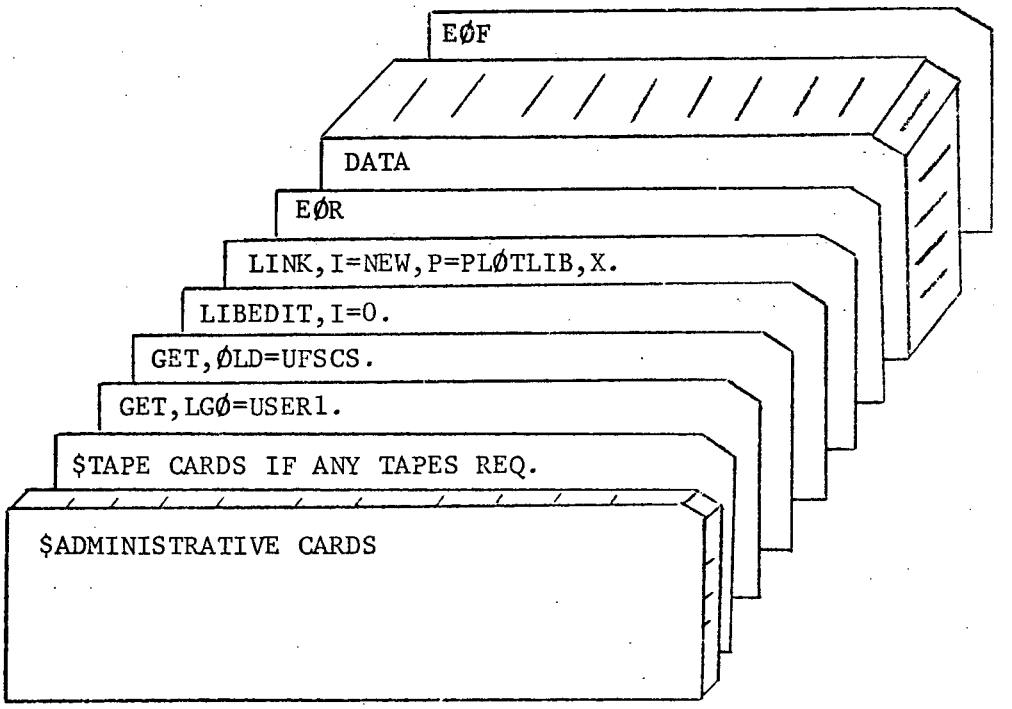
II. OVERALL DECK SET UP

CDC 6500

1. The following diagram assumes that the program, in relocatible form, is stored on disk under file name UFSCS.



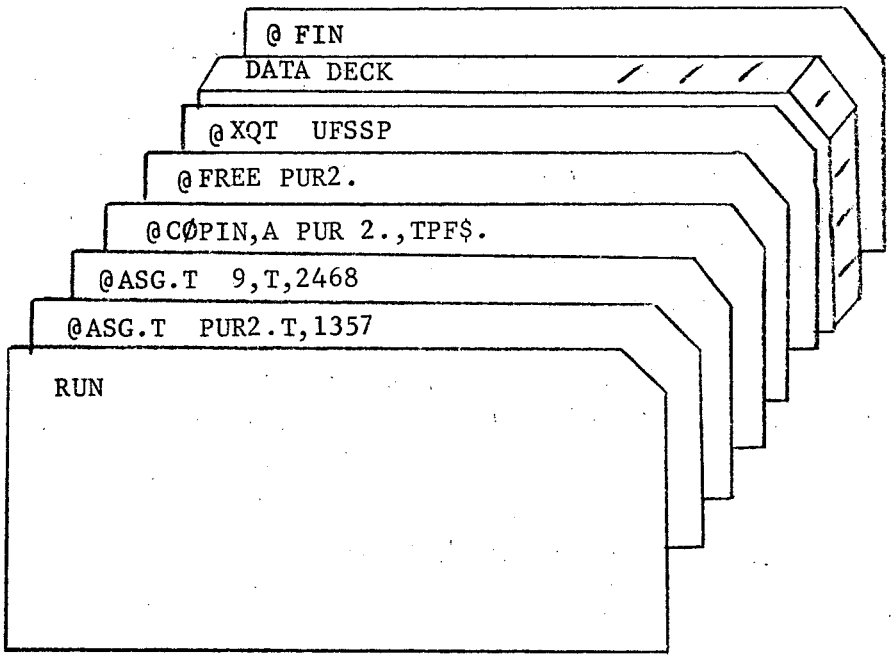
2. Deck setup for UFSSP with use of control system assuming "USER" subroutine is on a relocatible file - USER1.



3. If desired the user subroutine can be compiled from source cards and then the relocatible deck would be on LGØ and the remaining control cards would be identical to 2. above. The source deck could be part of the deck setup or come from a source file.

UNIVAC 1108

1. In order to exemplify the control cards necessary to run the UFSSP on the NASA/MSFC computing facilities, the following diagram assumes that the program resides on a magnetic tape with reel number 1357 and that the Structures Tape resides on reel number 2468.



2. Deck set up for UFSSP with use of control system assuming "USER" subroutine is on a relocatible file.

(Diagram to be supplied by MSFC Programming Staff)

III. TAPE/DISK/DRUM USAGE

Program Symbol	CDC File No.	UNIVAC File No.	Tape Usage	Mode
AS147T	16 or 25	9 or 25	Structures Tape (can be on cards)	Binary or BCD
MØDTPE	40	8	Modal Data Tape	Binary
HISTPE	8	21	History Data Tape	Binary
PLØTPE	50	3	CALCØMP Plot Tape (not defined for UNIVAC)	
IN	5	5	Input Card Set on Disk/Drum	BCD
ØUT	6	6	Print Data Set on Disk/Drum	BCD
INPSAV	30	1	Input Set for Previous Case on Disk/Drum	Binary
ICFILE	60	2	Temp Storage for Control System Modal Data on Disk/Drum	Binary

See problem definition for tape record formats.

IV. LIST OF STANDARD/NONSTANDARD LIBRARY ROUTINES

Name	Purpose/Comments
LIN	Linear Interpolation Subroutine
LESK	Linear Equation Solver
RKAM(S)	RUNGA KUTTA/Adams-Moulton Integration
CPLØT	CALCØMP Plot Driver Routine-Not Good on UNIVAC
XYPLØT	CALCØMP Plot Routine-Not Good for UNIVAC
FSF	" " " " " " "
INTBCD	" " " " " " "
PLØT	" " " " " " "
SINCØS	Sine/Cosine Routine (standard library routine)
SQRT	Square Root Routine " " "
ATAN	Arc Tangent Routine " " "
SETCØ	Dynamics Sequencing Routine

V. PROGRAM LOAD MAP

See listing of the program load with overlay structure and cross-reference information immediately following.

CDC Load Map

```
LOAD MAP.   OVERLAY              12/12/72. 20.45.01. PAGE    1

LOAD OPTIONS -   CF, CR, LR, X

FL REQUIRED TO LOAD    71200
FL REQUIRED TO RUN    146500


LOADER DIRECTIVES.

1. OVERLAY(UFSSP,0,0)
2. OVERLAY(UFSSP,1,0)
3. OVERLAY(UFSSP,2,0)
4. OVERLAY(UFSSP,3,0)
5. OVERLAY(UFSSP,4,0)
```

FWA OVERLAY 100 LWA OVERLAY 61222 LENGTH 61122

OVERLAY WRITTEN TO UFSSP

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
/CVLTAB$/	101	26		
MAIN	127	34	NEW	12/04/72.
GLOBAL	163	10	NEW	11/30/72.
ERROR	173	2465	NEW	12/11/72.
GJI	2660	132	NEW	03/08/72.
HEADE	3012	43	NEW	03/08/72.
MASTCN	3055	272	NEW	11/28/72.
ACCOER	3347	12	RUNLIB	*NO-DATE*
DUMP	3361	302	RUNLIB	11/20/70.
ENDFIL	3663	73	RUNLIB	*NO-DATE*
OUTPTC	3756	1334	RUNLIB	04/06/72.
OVERLAY	5312	127	RUNLIB	11/26/72.
REWINM	5441	73	RUNLIB	*NO-DATE*
SINCOS	5534	77	RUNLIB	*NO-DATE*
SQRT	5633	43	RUNLIB	*NO-DATE*
SYSTEM	5676	1214	RUNLIB	04/06/72.
GETBA	7112	17	RUNLIB	*NO-DATE*
SIO$	7131	407	RUNLIB	04/06/72.
SYSTEMQ	7540	43	RUNLIB	11/26/72.
CPUCOD	7603	13	RUNLIB	05/26/71.
CPUCIO	7616	257	RUNLIB	09/19/72.
CPUSYS	10075	24	RUNLIB	10/10/71.
/FIOBUF$/	10121	11760		
/STCARD/	22101	2		
/GIMOTR/	22103	6		

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
/TPHASE/	22111	1		
/FLAG/	22112	610		
/DISTRB/	22722	1252		
/DYNINP/	24174	2443		
/ORBQ/	26637	57		
/CRTFCG/	26716	2		
/OUTP/	26720	667		
/SEQP/	27607	516		
/STVCTR/	30325	1272		
/TBLINP/	31617	1152		
/FTOFQ/	32771	516		
/MODEQ/	33507	16403		
/RKAMST/	52112	7		
/OUTCOM/	52121	107		
/CONINT/	52230	4645		
/INPFLG/	57075	464		
/CONLOG/	57561	1211		
/FICBUFR/	60772	230		
//	135632	10574		

FWA OVERLAY 61222 LWA OVERLAY 114506 LENGTH 33264

OVERLAY WRITTEN TO UFSSP

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
INPCON	61223	336	NEW	11/30/72.
HEADI	61561	150	NEW	03/08/72.
INCCNT	61731	556	NEW	12/09/72.
INFLG	62507	124	NEW	11/28/72.
INPCH	62633	565	NEW	11/28/72.
INPDIP	63420	425	NEW	11/28/72.
INPDYP	64045	275	NEW	03/08/72.
INPICP	64342	201	NEW	03/08/72.
INPREC	64543	1365	NEW	11/28/72.
INPRT	66130	1157	NEW	12/09/72.
INPSTR	67307	1323	NEW	11/28/72.
INPTAP	70632	307	NEW	03/08/72.
INP1ER	71141	353	NEW	11/28/72.
INP2ER	71514	330	NEW	11/28/72.
INP3ER	72044	336	NEW	11/28/72.
SETCO	72402	1272	NEW	03/08/72.
UTILP	73674	60	NEW	03/08/72.
UTILPR	73754	345	NEW	03/08/72.
INPUTB	74321	315	RUNLIB	01/16/72.
INPUTC	74636	1211	RUNLIB	04/06/72.
INPUTN	76047	1661	RUNLIB	08/11/71.
OUTPTB	77730	250	RUNLIB	06/02/71.
/INPUT/	100200	3343		
/INPUT1/	103543	4564		
/INPUT2/	110327	1006		

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
/INPUT3/	111335	3151		

10

FWA OVERLAY 61222 LWA OVERLAY 104266 LENGTH 23044

OVERLAY WRITTEN TO UFSSP

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
MODCTL	61223	1070	NEW	11/30/72.
CROSS	62313	50	NEW	03/08/72.
DOT	62363	30	NEW	03/08/72.
GETMDE	62413	361	NEW	03/08/72.
MCALC	62774	2477	NEW	11/30/72.
MINT	65473	373	NEW	03/08/72.
RMTAPE	66066	616	NEW	11/30/72.
SPECFB	66704	4735	NEW	03/08/72.
IFENDF	73641	32	RUNLIB	*NC-DATE*
INPUTB	73673	315	RUNLIB	01/16/72.
INPUTC	74210	1211	RUNLIB	04/06/72.
OUTPTB	75421	250	RUNLIB	06/02/71.
/ICTLMQ/	75671	565		
/IMCDEQ/	76456	5610		

FWA OVERLAY 61222 LWA OVERLAY 135632 LENGTH 5441C

OVERLAY WRITTEN TO UFSSP

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
CALCPR	61223	234	NEW	12/12/72.
DERIV	61457	36	NEW	12/12/72.
DFIRST	61515	301	NEW	03/08/72.
ERROR1	62016	25	NEW	08/29/72.
GETST	62043	155	NEW	03/08/72.
HEAD	6222C	47	NEW	08/29/72.
HISTPC	62267	7C0	NEW	11/28/72.
HISTPL	63167	454	NEW	11/27/72.
INDER	63643	44	NEW	03/08/72.
ITIMER	63707	12	NEW	03/08/72.
ORBIT	63721	731	NEW	11/06/72.
OUTCAL	64652	152	NEW	08/29/72.
PRINCN	65024	1534	NEW	12/05/72.
PRMOTN	6656C	203	NEW	03/08/72.
RIGAUX	66763	764	NEW	08/29/72.
RKAMS	67747	576	NEW	03/08/72.
STOST	7C545	165	NEW	03/08/72.
UNPSTD	70732	152	NEW	03/08/72.
ABC	71104	146	NEW	03/08/72.
ABPC	71252	101	NEW	03/08/72.
AEBC	71353	175	NEW	03/08/72.
AEBPC	7155C	115	NEW	03/08/72.
CDEL	71665	101	NEW	03/08/72.
CROP	71766	45	NEW	03/08/72.
CROSS	72033	50	NEW	03/08/72.

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
DOT	72103	30	NEW	03/08/72.
GDOTJ	72133	124	NEW	03/08/72.
GJSUB	72257	77	NEW	03/08/72.
LIN	72356	122	NEW	03/08/72.
MNTR	725CC	45	NEW	03/08/72.
MV3X3	72545	70	NEW	03/08/72.
NNTR	72635	61	NEW	03/08/72.
NTERP	72716	51	NEW	03/08/72.
SCAL	72767	52	NEW	03/08/72.
STBA	73041	51	NEW	03/08/72.
STZ	73112	41	NEW	03/08/72.
TAN	73153	37	NEW	03/08/72.
UVOOT	73212	46	NEW	03/08/72.
INTERC	7326C	111	NEW	12/12/72.
CFIRST	73371	136	NEW	11/30/72.
RGDIS1	73527	161	NEW	12/04/72.
CONSYS	7371C	214	NEW	12/08/72.
SNGPOL	74124	140	NEW	11/27/72.
DBLPOL	74264	247	NEW	12/08/72.
SUM2	74533	112	NEW	11/27/72.
SUM1	74645	55	NEW	11/27/72.
SUM3	74722	133	NEW	11/27/72.
MULDIV	75055	112	NEW	11/27/72.
DZLIM	75167	140	NEW	11/27/72.
QUAN	75327	114	NEW	11/27/72.
QUTZ	75443	55	NEW	11/27/72.
SINFCT	7552C	47	NEW	11/27/72.
HYS	75567	151	NEW	11/27/72.
RELAY	7574C	214	NEW	11/27/72.
DELAY	76154	166	NEW	11/27/72.
TIMFCT	76342	223	NEW	11/27/72.
USER	76565	110	NEW	12/12/72.
CSFORC	76675	514	NEW	12/08/72.
CSSEN	77411	561	NEW	12/08/72.
PACCSV	100172	30	NEW	11/30/72.

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
UNPCSV	100222	30	NEW	11/30/72.
DERIV1	100252	525	NEW	12/12/72.
FLXAUX	100777	1155	NEW	10/04/72.
FLXCOM	102154	1002	NEW	08/29/72.
FLXDIS	103156	542	NEW	03/08/72.
FLXLOD	103720	720	NEW	03/08/72.
GFEFD	104640	167	NEW	03/08/72.
GFMERD	105027	432	NEW	03/08/72.
GIMRT	105461	255	NEW	09/26/72.
LESK	105736	471	NEW	03/08/72.
MATDMP	106427	436	NEW	03/08/72.
MATPRT	107065	150	NEW	03/08/72.
RIGCOM	107235	3501	NEW	10/04/72.
RIGDIS	112736	522	NEW	03/08/72.
RIGLOD	113460	220	NEW	03/08/72.
FLXOLD	113700	174	NEW	08/28/72.
RIGOLD	114074	216	NEW	09/16/72.
ASINCOS	114312	136	RUNLIB	*NO-DATE*
ATAN	114450	74	RUNLIB	*NO-DATE*
OUTPTB	114544	250	RUNLIB	06/02/71.
OUTPTN	115014	547	RUNLIB	*NO-DATE*
RBAREX	115563	57	RUNLIB	*NO-DATE*
ALNLOG	115642	67	RUNLIB	*NO-DATE*
EXP	115731	57	RUNLIB	*NO-DATE*
/CSDATA/	116010	474		
/TJHIST/	116504	66		
/CALLCD/	116572	504		
/CONTF/	117276	2552		
/PRNCAL/	122050	3117		
/DFLAG/	125167	26		
/ERASE/	125215	1173		
/RBAUXQ/	126410	3421		
/TDPARM/	132031	505		
/CONST/	132536	30		
/ORTHCK/	132566	12		

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
/ID1STQ/	1326CC	13		
/CNSYSD/	132613	233C		
/FBAUXQ/	135143	467		

LOAD MAP. OVERLAY CVLO4CO 12/12/72. 20.45.01. PAGE 11

FWA OVERLAY 61222 LWA OVERLAY 127254 LENGTH 46032

OVERLAY WRITTEN TO UFSSP

BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE
RDLCAD	61223	107	NEW	09/28/72.
CPLOT	61332	21653	NEW	12/09/72.
RDLD	103205	77	NEW	09/28/72.
FSF	103304	44	NEW	03/07/72.
INTBCD	103350	47	NEW	03/07/72.
XYPLCT	103417	11050	NEW	12/09/72.
AXIS	114467	414	PLCTLIB	*NC-DATE*
LINE	115103	262	PLCTLIB	*NC-DATE*
NUMBER	115365	266	PLOTLIB	*NC-DATE*
PLOT	115653	733	PLCTLIB	04/16/72.
SCAL	116606	150	PLCTLIB	*NC-DATE*
SYMBOL	116756	420	PLCTLIB	*NC-DATE*
BACKSP	117376	174	RUNLIB	08/17/70.
IFENDF	117572	32	RUNLIB	*NC-DATE*
INPUTB	117624	315	RUNLIB	01/16/72.
ALNLCG	120141	67	RUNLIB	*NC-DATE*
RBATEX	120230	41	RUNLIB	*NC-DATE*
RBAREX	120271	57	RUNLIB	*NC-DATE*
EXP	120350	57	RUNLIB	*NC-DATE*
/RDTEM/	120427	3410		
/PLOT/	124037	23		
/CONCNV/	124062	5		
/CPLXY/	124067	3164		
/NCASE/	127253	1		

UNIVAC Load Map

```
MAP,15 UFSSP,UFSSP
MAP 17M1-10/27-09:05 -(.J)

  1.     LIB SYS$*MSFC$
  2.         SEG A
  3.         IN MAIN,GLOBAL,ERROR,MASTCN,HEADE,CPLOT,CROSS,DOT, GJI
  4.         SEG B*,(A)
  5.         IN INPCON,INPRED,INPCH,INPIER,INP2ER,INP3ER,INPSTR,INCONT
  6.         IN INFLG,SETCO,INPRT,INPICP,INPDIP,INPDYP,INPTAP,UTILP
  7.         IN UTILPR,HEAD1,INPUT,INPUT1,INPUT2,INPUT3
  8.         SEG C*,B
  9.         IN GETMDE,MCALC,MODCTL,RMTAPE,MINT,SPECFB,IMODEQ,ICTLMQ
 10.         SEG D*,C
 11.         IN CALCPR,DERIV,GETST,RIGAUX,PRINCN,HISTPC,HISTPL,ERROR1,HEAD
 12.         IN DFIRST,INDER,ORBIT,PRMOTN,ABC,ABPC,AEBC,AEBPC
 13.         IN CDEL,CROP,GDOTJ,GJSUB,LIN,ØUTCAL,UNPSTD
 14.         IN MNTR,MV3X3,NNTR,NTERP,SCAL,STBA,STZ,TAN
 15.         IN UVDOT,STOST,RKAMS,PRNCAL,CONTF,TDPARM,RBAUXQ,ERASE
 16.         IN DFLAG,CONST,IDISTQ,CSDATA,TJHIST,CALLOD,ORTHCK
 17.         SEG E*,(D)
 18.         IN INTERC,CFIRST,UNPCSV,CSSEN,CONSYS,CSFORC,PACCSV
 19.         IN SNGPØL,DBLPØL,SUM2,SUM1,SUM3,MULDIV,DZLIM,QUAN
 20.         IN QUTZ,SINFCT,HYS,RELAY,DELAY,TIMFCT,USER,RGDIS1,CNSYSD
 21.         SEG F*,E
 22.         IN DERIV1,MATDMP,MATPRT,FLXAUX,FLXDIS,FLXLOD,GIMRT
 23.         IN FLXCOM,GFEFD,GFMERD,RIGCOM,RIGDIS,RIGLOD,LESK,RIGCLD
 24.         IN FLXCLD,FBAUXQ

ADDRESS LIMITS  00100   043737    044000 144137
SEGMENT LOAD TABLE                044000 044027
STARTING ADDRESS 011003
```

WORDS DECIMAL 17888 IBANK 32864 DBANK

SEGMENT A 001000 012453 044030 122051

NFTVS/FOR	1	001000 001022			
NBFUUS/FOR			2	044030	046231
NCNVTS/FOR57	1	001023 001255	2	46232	046321
NCLOSS/MSFC57	1	001256 001424		6322	046347
NRBLKS/MSFC55	1	001425 001513		6350	046351
NFTCHS/FOR57	1	001514 002011		352	046407
NSWTCS/FOR	1	002014			
NBSBLS/FOR	1	002			
NUPDAS/FOR	1				
NWBLKS/MSFC57	1				046412
NBDCVS/FOR57					046452
NOTINS/MSFC55					46463
NOUTS/FOR57					46514
NFMTS/FOR57					6533
NIOERS/M					656
NFCH					733
					05
N					4
ER					
HSI					
NWE					
NFIN					
NRWNL					
NFOUT					
NIERS/					
NOBUFS/					
SQRTS/FL					050265
NERRS/FO				266	050442
TRACE				050443	050450
			2	050451	050533
INPFLG (COI				050534	051217
FTORQ (COMM				051220	051735
SEQP (COMMON				051736	052453
OUTP (COMMON				052454	053342
RKAMST (COMMO				053343	053351
ORBQ (COMMON B				053352	053430
STVCTR (COMMON				053431	054727
DISTRB (COMMON L K)				054730	056201
TBLINP (COMMON BLOCK)				056202	057353
OUTCOM (COMMON BLOCK)				057354	057462
DYNINP (COMMON BLOCK)				057463	062125
CONINT (COMMON BLOCK)				062126	066126
MODEQ (COMMON BLOCK)				066127	102141
FLAG (COMMON BLOCK)				102142	102751
BLANKSCOMMON (COMMON BLOCK)				102752	120205
MAIN	1	011303 011612	0	120206	120207
			2	BLANKSCOMMON	
GLOBAL	3	FLAG	2	BLANKSCOMMON	
	5	DYNINP	4	DISTRB	

OUT OF DATE

(TO BE SUPPLIED BY MSFC PROGRAMMING STAFF)

VI. BLOCK DIAGRAM OF MASTCN

MASTCN is the master control subroutine which controls the program.